

The equation used is written $v = x + by + cz$. In which v is the variation of the minimum temperature from the evening dewpoint; b is the evening relative humidity, and c is the square of the relative humidity; x , y , and z are the three unknowns, which are evaluated from three normal equations which are readily written by the star point method, after the data have been properly charted.

The results are remarkably accurate. The studies show that the minimum temperature can be closely predicted in the orchard at considerable distance from the observing station; that the hygrometric observations made at noon may be used quite as well in some instances as those made in the evening, and that the equation will sometimes apply as well to cloudy as to clear nights.

DISCUSSION.

Prof. H. J. Cox remarked that the cranberry marshes of Wisconsin showed extraordinarily low temperatures, considering the high humidities, which condition he ascribed to the shallowness of the moist blanket of air.

Prof. W. J. Humphreys told of a case where, in order to protect his orchard, a farmer had driven his cattle and horses back and forth through the orchard, and the animal heat was sufficient to protect the trees against frost. This has the double advantage of supplying heat at moderate temperature in such a manner that it will not rise quickly above the trees, and of stirring the air.

FORECASTING FROSTS.

By B. A. KEEN.

[Discussed by J. Warren Smith.

(Nature, Jan. 1, 1920, p. 450.)

The author refers to different methods of frost protection and minimum temperature forecasting. Under frosts the writer says:

Up to the present, no complete correlation has been made of frost in any particular locality and its causes. For this purpose an examination by statistical methods of a series of continuous observations (of the automatic recording type) of meteorological factors is needed. The published papers deal usually with one factor, such as dewpoint or air temperature, and the number of daily observations made is small. This is due, no doubt, to the necessity of keeping the cost of apparatus and working as low as possible for the sake of the growers. However, a general idea of the factors concerned can be obtained from a broad survey of the various papers.

For several seasons the Weather Bureau has been making a careful temperature and frost survey in the citrus district at Pomona, Calif., and the deciduous fruit orchards near Medford, Oreg. Very valuable data have been collected on temperature differences as affected by topography, temperature fluctuations as affected by wind movement, changes in the dewpoint during the night, radiation with and without a smoke or smudge cover, and the temperature at different elevations when orchard heating is going on. A large number of thermometers have been exposed and special long-range thermographs kept in use. The radiation observations have been made with special apparatus used by the Solar Radiation Division of the Bureau. The work is now under the direction of Mr. Floyd D. Young, and the results will soon appear in print (in *Farmers' Bulletin* 1096).

One important result has been to show that so-called smudges are of small value as compared with the dry-heat method of orchard heating.

In connection with the forecasting problem Mr. Keen refers to a study by Hellman on the effect of an overcast sky on air temperatures near the ground. (Preuss. Akad. Wiss., Berlin, 38, 1918, p. 806); on various methods of predicting the minimum temperatures on radiation nights by Smith (U. S. MONTHLY WEATHER REVIEW 42, 1914, 573; 4, 1917, p. 402) and some observations by Franklin on the cooling of the soil at night, with special reference to late spring frosts. (Proc. Royal Soc., Edin., 39, 1919, p. 120.)

The credit given J. Warren Smith in originating the median-hour method of predicting minimum temperatures should be only in the application of the idea which was first noticed by the writer in an article by E. A. Beals.

Referring to the study by T. B. Franklin, the writer says:

"As a result of observations of temperatures in the air, on the soil, and at a depth of 4 inches, Franklin concludes that a prediction of frost depends on assessing the value of: (1) Average relative humidity during the night; (2) the temperature of a given depth (4 inches) at the time of surface minimum temperature; (3) the conductivity of the layer between the assigned depth and the surface; and (4) the difference between the surface-soil minimum and that of the air above it. These determinations are necessary because: (1) The radiation from the soil on calm, clear nights is a function of the relative humidity (A. Ångström, Smithsonian Misc. Coll., 65 No. 3); (2) the radiation from the soil can be accounted for in balancing the upward conduction and the latent heat of freezing, the residue only cooling the soil; and (3) the temperature of the surface soil rapidly falls sufficiently below the temperature of the 4-inch depth to make the conduction from this depth balance the radiation; after this the surface temperature falls no faster than that of the 4-inch depth."

WINTER INJURY OF FRUIT TREES.

By JOSEPH ASKAMP.

(Abstracted from Circ. 87, 12 p., illus., Purdue Univ. Agr. Expt. Sta., 1918.)

The severe winter of 1917-18 has caused irreparable damage to thousands of peach and apple orchards in Indiana.¹ The heaviest toll was taken of the peaches, amounting all the way from very slight or no injury to the complete destruction of entire orchard tracts. It seems safe to say that for the State as a whole the damage has cut the bearing acreage of peaches at least 60 per cent. The mortality among young peach trees which had not yet borne fruit was small, however, so that in a short time normal production should be restored.

"A part of the acreage where the injury was severe will probably not be planted again to peaches. This is as it should be, for many of these locations were not well adapted to such a tender fruit. While the trees in many such locations were heretofore able to survive the winters, the buds or blossoms were more commonly killed than in more favorable situations. * * *

* * * "In the case of the apple, the young trees from 3 to 14 years old suffered the greatest injury. * * *

¹ During December and January unusually severe weather prevailed over the greater part of the country east of the Rocky Mountains, especially in the length of time that low temperatures were maintained and the large area involved. The cold weather continued into the first part of February in the northeast.

In Illinois the temperature fell to -23° F. in December and January and to -24° in February. A record of -30° was reached in Indiana in December, -24° in January, and -22° in February. In Ohio the lowest reported was -31° in December and -24° in January and February. The temperature fell to from 40° to 42° below zero F. at a number of places in the plateau districts of New York on December 30, and to below -30° during both January and February. (See MONTHLY WEATHER REVIEW, Dec., 1918, 46: 570-580)—J. W. S.